Subnetting

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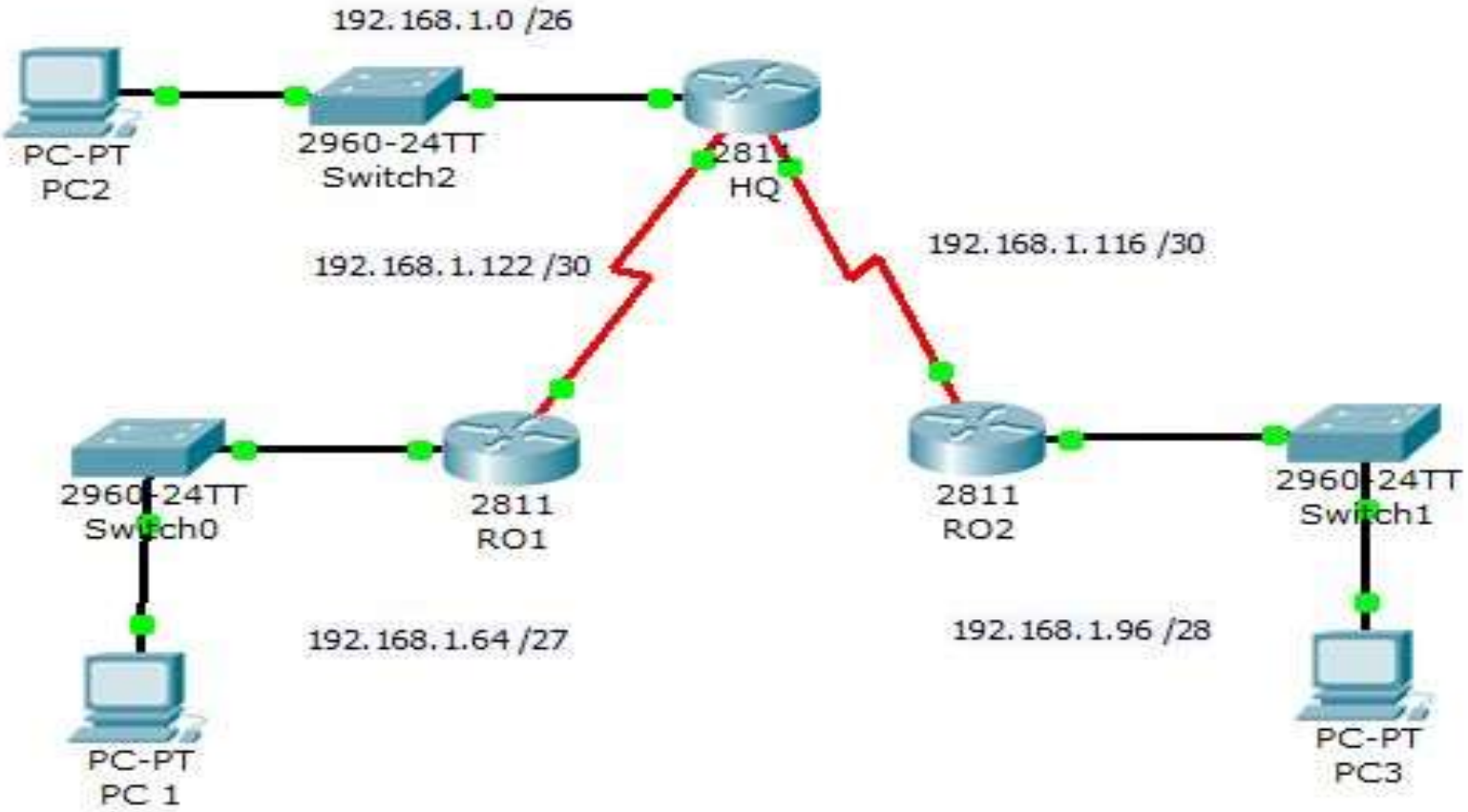
What is Subnetting?

- Allows Creating multiple network from a single address block.
- Subnetting is a process of breaking large network in small networks known as subnets.

Diagram


192.168.1.0 /26
PC-PT
PC2
2960-24TT
Switch2
HQ
192.168.1.122 /30
192.168.1.116 /30
2960-24TT
Switch0
2811
RO1
2811
RO2
2960-24TT
Switch1
192.168.1.64 /27
192.168.1.96 /28
PC-PT
PC 1
PC-PT
PC3

Why Subnetting?

- Maximise addressing efficiency.
- Extend the life of IPV4.
- Public IPV4 Addresses are scare.
- Easy to manage.
- Subnetting reduces network traffic by removing collision and broadcast traffic, that overall improve performance.
- Subnetting allows you to apply network security polices at the interconnection between subnets

How?

CIDR [Classless Inter Domain Routing]

- CIDR is a slash notation of subnet mask. CIDR tells us number of on bits in a network address

CIDR	Decimal	Binary
/25	128	10000000
/26	192	11000000
/27	224	11100000
/28	240	11110000
/29	248	11111000
/30	252	11111100

Formulas & Variables

- h=number of host bits
- n=number of host bit use in network bits

- Number of new networks reulting from the subnetting: =2^n
- Number of hosts per new network: =2^h-2

One is network another is broadcast

- **Broadcast** address is the last address of subnet.
- **Block size** or increment number is used to calculate the valid subnets

Example:-1

- Subnet base address

192	168	1	0/24
11111111	11111111	11111111	00000000
N	N	N	H

- New CIDR length /25

  →255.255.255.128(Subnet Mask)

192	168	1	0/25
11111111	11111111	11111111	10000000

- n = 1 [Number of host bit used in network]
- h = 7 [Remaining host bits]

Example:-1

- Total subnets (2^n) :- 2^1 = 2.
- Block size (256 - subnet mask) :- 256 - 128 = 128
- Valid subnets 0,128
- Valid host per subnets (2^h-2)=2^7-2=126

Subnets	Subnet 1	Subnet 2
Network ID	192.168.1.0	192.168.1.128
First host	192.168.1.1	192.168.1.129
Last host	192.168.1.126	192.168.1.254
Broadcast ID	192.168.1.127	192.168.1.255

Example:-2

- New Perfix length /26

  →255.255.255.192(Subnet Mask)

192	168	1	0/26
11111111	11111111	11111111	11000000

n

- n = 2 [Number of host bit used in network]
- n = 6 [Remaining host bits]
- Total subnets (2^n) :- 2^2 = 4.
- Block size (256 - subnet mask) :- 256 - 192 = 64.
- Valid subnets (Count blocks from 0) :-

  0,64,128,192

Example:-2

- Total hosts (2^h) :- $2^6 = 64$
- Valid hosts per subnet (2^h- 2) :- 64 - 2 = 62

Subnets	Subnet 1	Subnet 2	Subnet 3	Subnet 4
Network ID	0	64	128	192
First host	1	65	129	193
Last host	62	126	190	254
Broadcast ID	63	127	191	255

Subnet Mask

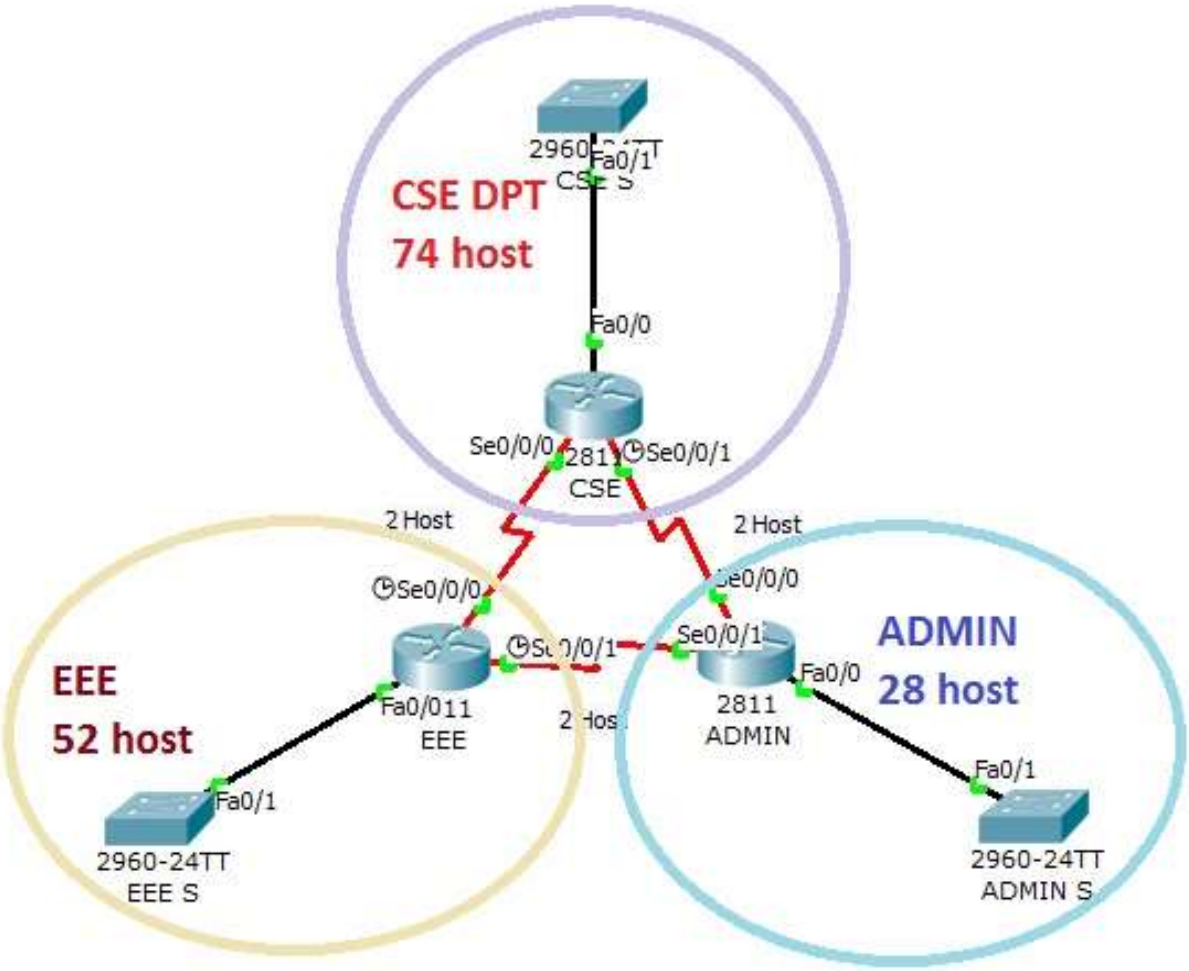
- Subnet mask is a 32 bits long address used to distinguish between network address and host address in IP address. Subnet mask is always used with IP address. Subnet mask has only one purpose, to identify which part of an IP address is network address and which part is host address.

IP	192	168	1	1
Subnet mask	255	255	255	128

Case Study

In Real Life Example

Diagram


CSE DPT
74 host
Fa0/1
Fa0/0
Se0/0/0
Se0/0/1
CSE
2 Host
2 Host
Se0/0/0
Se0/0/1
Fa0/0
Fa0/0
2811
ADMIN
ADMIN
28 host
EEE
52 host
Fa0/1
2960-24TT
EEE S
Fa0/1
2960-24TT
ADMIN S

In real life scenario

- some subnets may require large number of host addresses while other may require only few addresses.
- Assume that you are a network administrator & EDU has three departments connected with wan links.
  - CSE department has 74 computers.
  - EEE department has 52 computers.
  - Administrative department has 28 computers.
  - All departments are connected with each other via wan link.
  - Each wan link requires two IP addresses.

Choose address

- First choice (*purchase a class B IP address*)

172.168.1.0/23

Subnetting of this address would give us 128 subnets and 510 hosts in each subnet. Our network requires only 6 subnets and 160 addresses. We would have to pay for 65356 addresses while you need only 160 addresses. Every IP address adds more dollars in company bill. Would you consider this address space for company?

- Second choice (*purchase at least two Class C IP addresses)*

192.168.1.0/25

192.168.1.0/26

- Subnetting of first address 192.168.1.0/25 would give us 2 subnets and 126 hosts in each subnet.
- Subnetting of second address 192.168.1.0/26 would give us 4 subnets and 62 hosts in each subnet.
- Collectively we are getting 6 subnets and 500 hosts from these two address spaces. We are still wasting more than 300 IP address, and we would have to purchase two address spaces.

Step-1

- Oder all segments according the hosts requirement (Largest to smallest).

Subnet	Segment	Host
1	CSE	74
2	EEE	52
3	Administration	28
4	Wan link 1	2
5	Wan link 2	2
6	Wan link 3	2

Step-2

- Do Subnetting for largest segment. Our largest segment needs 74 host addresses. /25 provide us two subnets with 126 hosts in each subnet.

192.168.1.0/25

Subnet	Subnet 1	Subnet 2
Network ID	192.168.1.0	192.168.1.128
First host address	192.168.1.1	192.168.1.129
Last host address	192.168.1.126	192.168.1.254
Broadcast ID	192.168.1.127	192.168.1.255

Step-3

- Assign subnet mask to the largest segment. As you can see in above table, subnet 1 fulfill our largest segment requirement. Assign it to our segment.

Segment	CSE
Requirement	74
CIDR	/25
Subnet mask	255.255.255.128
Network ID	192.168.1.0
First hosts	192.168.1.1
Last hosts	192.168.1.126
Broadcast ID	192.168.1.127

Step-4

- Do subnetting for second largest segment from next available subnet. Next segment requires 52 host addresses. Subnetting of /25 has given us two subnets with 128 hosts in each, from that we have assigned first subnet to **CSE** segment. Second segment is available, we would do subnetting of this.
- /26 provide us 4 subnets with 62 hosts in each subnet.

192.168.1.0/26

Subnet	Subnet 1	Subnet 2	Subnet 3	Subnet 4
Network ID	0	64	128	192
First address	1	65	129	193
Last address	62	126	190	254
Broadcast ID	63	127	191	255

- We cannot use subnet 1 and subnet 2 (address from 0 to 127) as they are already assigned to **CSE** department. We can assign subnet 3 to our **EEE** department.

Segment	EEE
Requirement	52
CIDR	/26
Subnet mask	255.255.255.192
Network ID	192.168.1.128
First hosts	192.168.1.129
Last hosts	192.168.1.190
Broadcast ID	192.168.1.191

Step-5

- Our next segment requires 28 hosts. From above subnetting we have subnet 3 and subnet 4 available. Do subnetting for the requirement of 28 hosts. 192.168.1.0/27

Subnet	Sub 1	Sub 2	Sub 3	Sub 4	Sub 5	Sub 6	Sub 7	Sub 8
Net ID	0	32	64	96	128	160	192	224
First Host	1	33	65	95	129	161	193	225
Last Host	30	62	94	126	158	190	222	254
Broad-cast ID	31	63	95	127	159	191	223	255

- Subnets 1 to 6 [address from 0 to 191] are already occupied by previous segments. We can assign subnet 7 to this segment.

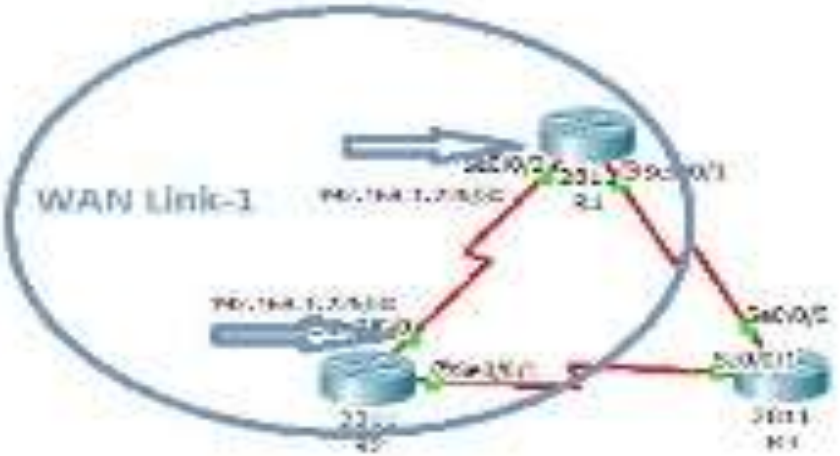
Segment	Administration
Requirement	28
CIDR	/27
Subnet mask	255.255.255.224
Network ID	192.168.1.192
First hosts	192.168.1.193
Last hosts	192.168.1.222
Broadcast ID	192.168.1.223

Step-6

- Our last three segments require 2 hosts per subnet. Do subnetting for these-192.168.1.0/30
- Valid subnets are:-
- 0,4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96,100,104,108,112,116,120,124,128,132,136,140,144,148,152,156,160,164,168,172,176,180,184,188,192,196,200,204,208,212,216,220,224,228,232,236,240,244,248,252,256

Subnet	Subnet 57	Subnet 58	Subnet 59
Network ID	224	228	232
First host	225	229	233
Last host	226	230	234
Broadcast ID	227	231	235

WAN Link 1

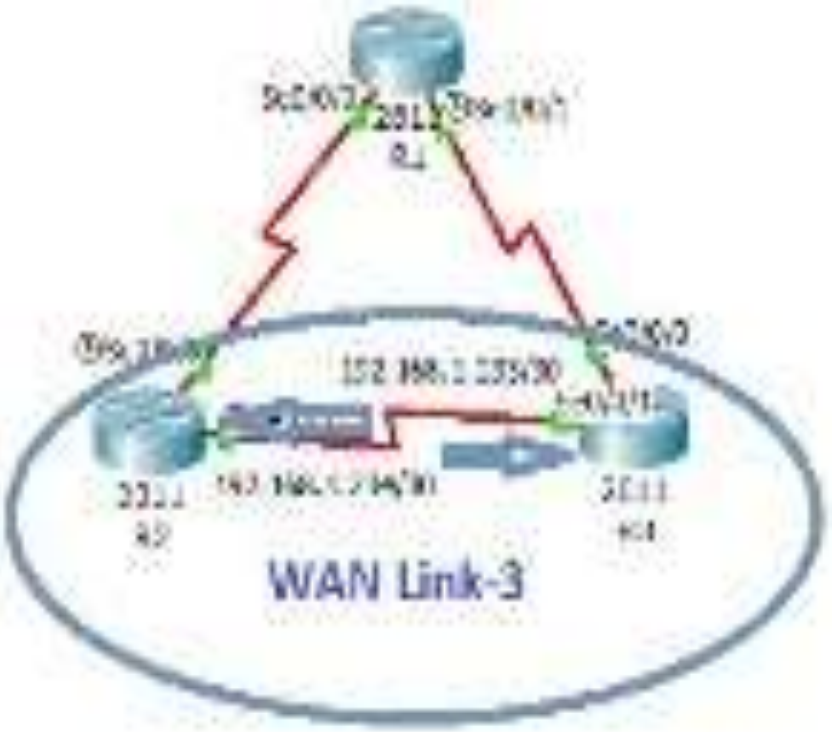


Segments	Wan Link 1
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.224
First hosts	192.168.1.225
Last hosts	192.168.1.226
Broadcast ID	192.168.1.227

WAN Link-2

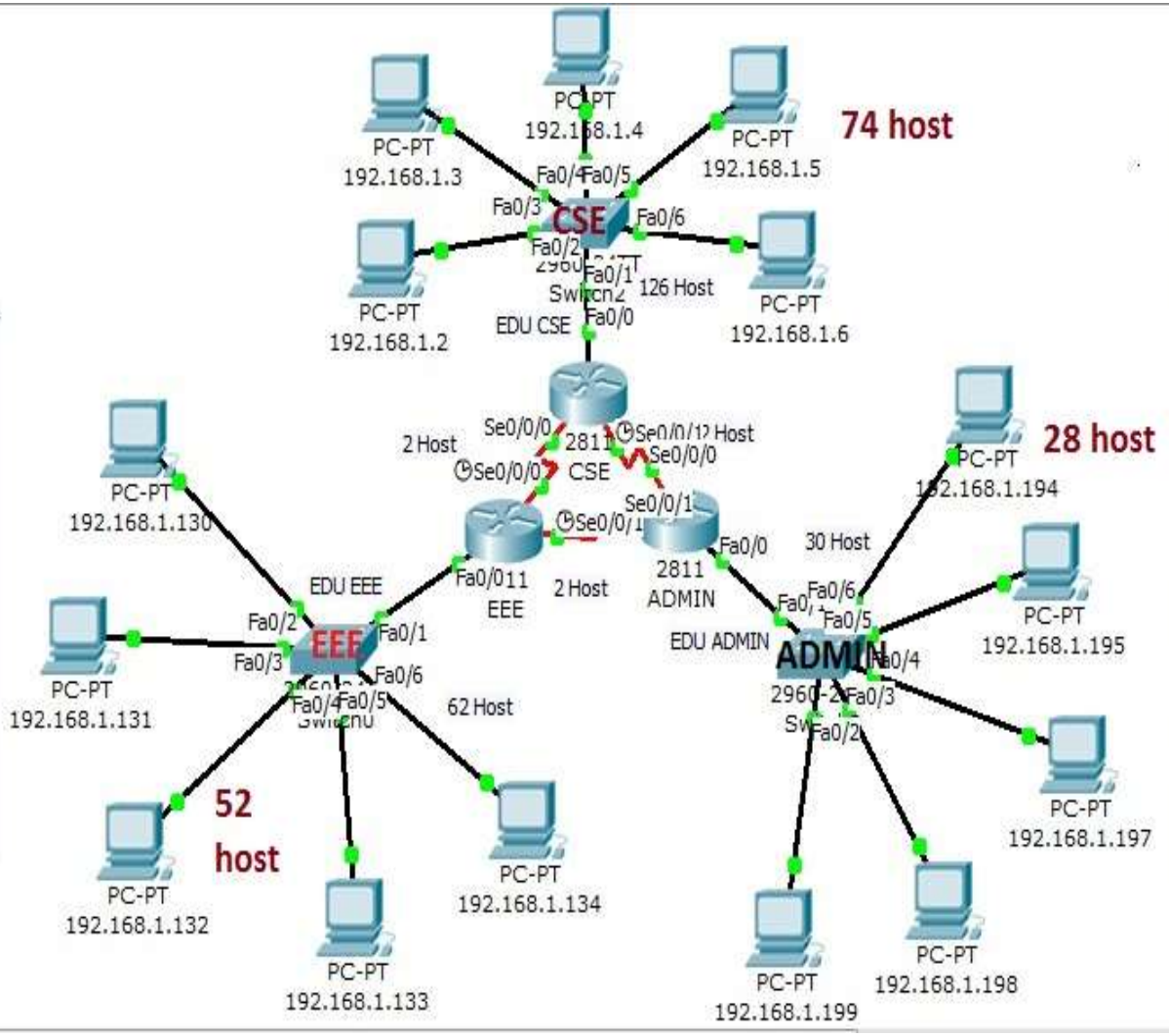
Segments	Wan Link 2
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.228
First hosts	192.168.1.229
Last hosts	192.168.1.230
Broadcast ID	192.168.1.231

WAN Link-3



Segments	Wan Link 3
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.232
First hosts	192.168.1.233
Last hosts	192.168.1.234
Broadcast ID	192.168.1.235

Whole Network



Starting address- 192.168.1.0/24

Subnet & EIGRP
N1-192.168.1.0-127/25
N2-192.168.1.128-191/26
N3-192.168.1.192-223/27
WAN1-192.168.1.224-227/30
WAN2-192.168.1.228-231/30
WAN3-192.168.1.232-235/30

WE need for
CSE-74
EEE-52
Administration-28
WAN 2+2+2

Subnet & EIGRP

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R1
f/0- 192.168.1.1
s/0/0/0-192.168.1.226
s/0/0/1-192.168.1.229
R2
f/0- 192.168.1.129
s/0/0/0-192.168.1.225
s/0/0/1-192.168.1.234
R3
f/0- 192.168.1.193
s/0/0/0-192.168.1.230
s/0/0/1-192.168.1.233

THANK YOU